GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3170511
Semester – VII
Subject Name: Transport Phenomena

Type of course: Professional Elective Course

Prerequisite: Concepts of Fluid Flow Operations, Process Heat Transfer and Mass Transfer Operations.

Rationale: This course will highlight coupling between three transport phenomena with applications in various disciplines in engineering and science, and will demonstrate to the students the common mathematical structure of transport problems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1.	**Introduction to Transport Phenomena:** Classification of Transport Processes, Conservation Laws, Vector and Tensor Calculus	3
2.	**Momentum Transport:** Newton's Law of Viscosity and viscosity estimation, Shell Momentum Balance, Application of Shell Momentum Balance for Flow of Falling Film, Flow Through Circular Pipe, Flow Through annulus, Flow Over Moving Plate, Flow of adjacent immiscible fluids, Equation of Changes: Continuity Equation, Equation Motion, Navier-Stokes Equation.	14
3.	**Steady State Heat Transport:** Fourier's Law of heat conduction and estimation of thermal conductivity, Shell Energy Balance, Applications of Shell Energy Balance for Heat Conduction with Electrical Source, Heat conduction with Nuclear heat source, Heat conduction Viscus heat source, Heat Conduction with Chemical Heat Source, Heat Conduction in a Cooling Fin, Forced Convection, The energy equation.	14
4.	**Mass Transport:** Fick's law of binary diffusion and estimation of diffusivity, Mass and Molar Concentrations, Mass Average and Molar Average Velocity, Mass and Molar Fluxes, Convective Mass and Molar Fluxes, Shell mass balance, Applications of Shell mass balance for Diffusion Through a Stagnant Gas Film, Diffusion with Heterogeneous Chemical Reaction, Diffusion With Homogeneous Chemical Reaction, Diffusion Into a Falling Liquid Film (Gas Absorption, Forced Convection Mass Transfer). The Equations of Continuity For a Multicomponent Mixture.	14

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
0	14	42	7	7	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. R. B. Bird, W. E. Stewart, E. N. Lightfoot. "Transport Phenomena", 2nd Edition, John Wiley & Sons (Asia) pvt. Ltd. 2002.
2. C. J. Geankoplis, "Transport Processes and Separation Process Principles", 4th Edition, PHI Learning Private Limited., New Delhi
3. W. J. Thomson, "Introduction to Transport Phenomena", Prentice Hall, 2000.

Course Outcomes: At the end of the course, the students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Analyze transport equations using vector and tensor calculus.	10
CO-2	Estimate transport properties such as viscosity, conductivity and diffusivity.	10
CO-3	Solve transport problems using shell balance methods.	35
CO-4	Develop equation of changes from conservation laws for momentum, energy and mass transport.	25
CO-5	Compare the mechanisms of transport processes	20

List of Open Source Software/learning website:

- SWAYAM and NPTEL courses available on Transport Phenomena
- MIT Open course lecture on Transport Phenomena
- OpenFOAM, SimFlow etc. softwares

w.e.f. AY 2018-19